
NEW SPECIES OF *CHUSQUEA* Yvonne Widmer² and Lynn G. Clark³ (POACEAE: BAMBUSOIDEAE) FROM COSTA RICA¹

ABSTRACT

Three new species of *Chusquea* from the upper montane forests of the Cordillera de Talamanca in Costa Rica are described and illustrated. *Chusquea tomentosa* and *C. subtilis* belong to *Chusquea* sect. *Longifoliae* L. G. Clark and are closely related to *C. foliosa* L. G. Clark. The third species, *C. talamancensis*, is a member of *Chusquea* sect. *Swallenochloa* (McClure) L. G. Clark and shows similarities to both *C. tonduzii* Hackel and *C. vulcanalis* (Soderstrom & C. Calderón) L. G. Clark. Revised keys to the species of sect. *Longifoliae* and sect. *Swallenochloa* in Costa Rica are provided.

Species of the woody bamboo genus *Chusquea* Kunth are often important components of montane forests in the New World (Veblen et al., 1977; Clark, 1989), but little ecological data relating to *Chusquea* is available. In Costa Rica, the upper montane forests along the Cordillera de Talamanca and volcanoes of the Cordillera Volcánica Central (northern slopes) are dominated by species of *Quercus* L., with a number of species of *Chusquea* found as elements in the understory or along the forest margins.

A Swiss Forestry Project, in association with the Centro Agronómico Tropical de Investigación y Enseñanza (CATIE) in Turrialba, Costa Rica, is developing a management plan for these forests.

As part of this project, the ecology of two species of *Chusquea* in these forests was studied (Widmer, in prep.). When the two species began to flower in 1987–1989, we were able to confirm that they were both undescribed. Material of a third undescribed species in flower was also collected during the ecological study.

In this paper, we describe and illustrate the three new species, *C. tomentosa*, *C. subtilis*, and *C. talamancensis*. The first two species are members of *Chusquea* sect. *Longifoliae*, and the third belongs to *Chusquea* sect. *Swallenochloa*. Revised keys to the species of these two sections in Costa Rica are included.

KEY TO THE SPECIES OF *CHUSQUEA* SECT. *LONGIFOLIAE* IN COSTA RICA (based on vegetative specimens)

- 1a. Thin, curly leafless fibrillar branchlets interspersed with the normal, leafy subsidiary branches; internodes scabrous; foliage leaf blades with the base rounded to rounded-truncate *C. scabra*
- 1b. Fibrillar branchlets absent; internodes usually smooth, rarely scabrous just below the nodes; foliage leaf blades with the base attenuate to rounded-attenuate.
 - 2a. Foliage leaf blades 0.6–1.3 cm wide; subsidiary branches 18–30 per node; culm leaf sheaths 0.7–3 times as long as blades *C. longifolia*
 - 2b. Foliage leaf blades 0.3–0.9(–1.1) cm wide; subsidiary branches 24–80(–150) per node; culm leaf sheaths 1.5–10.5(–14) times as long as blades.
 - 3a. Culm leaf sheaths abaxially scabrous to pilose, or sometimes glabrous; subsidiary branches 24–65 per node; inner ligules of foliage leaves 0.5–4 mm long; foliage leaf blades 0.4–0.9 cm wide *C. patens*
 - 3b. Culm leaf sheaths abaxially glabrous to pilose at the base; subsidiary branches 50–80(–150) per node; inner ligules of foliage leaves to 1.5 mm long; foliage leaf blades 0.3–0.7(–1.1) cm wide.
 - 4a. Foliage leaf blades abaxially tomentose; fimbriae at the apex of foliage leaf sheaths straight, few per tuft *C. tomentosa*
 - 4b. Foliage leaf blades abaxially glabrous to sparsely pilose with scattered hairs; fimbriae at the

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² CATIE/PFAF, Apartado 89, 7170 Turrialba, Costa Rica. Present address: Geobotanisches Institut ETHZ, 8044 Zürich, Switzerland.

³ Department of Botany, Iowa State University, Ames, Iowa 50011, U.S.A. Address correspondence to this author.

- apex of foliage leaf sheaths often curly, several to many per tuft.
- 5a. Foliage leaf blades with the base attenuate, L : W = (26-)30-48(-54); culm leaf sheaths 4.4-6.6 times as long as the blades *C. subtilis*
- 5b. Foliage leaf blades with the base rounded-attenuate, L : W = 20-40(-45); culm leaf sheaths 1.5-5.4 times as long as the blades *C. foliosa*

KEY TO THE SPECIES OF *CHUSQUEA* SECT. *LONGIFOLIAE* IN COSTA RICA
(based on flowering specimens)

- 1a. Primary branches of panicle strongly spreading *C. patens*
- 1b. Primary branches of panicles appressed or ascending.
- 2a. Sterile lemma II $\frac{3}{4}$ - $\frac{7}{8}$ the spikelet length; thin, curly, leafless fibrillar branchlets interspersed with the normal, leafy subsidiary branches; internodes scabrous *C. scabra*
- 2b. Sterile lemma II equalling or nearly equalling the spikelet length; fibrillar branchlets absent; internodes usually smooth, rarely scabrous just below the nodes.
- 3a. Spikelets 10.4-20.6 mm long; foliage leaf blades 0.6-1.3 cm wide; subsidiary branches 18-30 per node; culm leaf sheaths 0.7-3 times as long as the blades *C. longifolia*
- 3b. Spikelets 8.4-15 mm long; foliage leaf blades 0.3-0.7(-1.1) cm wide; subsidiary branches 50-80(-150) per node; culm leaf sheaths 1.5-10.5(-14) times as long as the blades.
- 4a. Spikelets 11.5-15 mm long; sterile lemma I $\frac{5}{8}$ - $\frac{2}{3}$ the spikelet length; foliage leaf blades abaxially tomentose *C. tomentosa*
- 4b. Spikelets 8.4-11.8 mm long; sterile lemma I $\frac{2}{3}$ - $\frac{3}{4}$ the spikelet length; foliage leaf blades abaxially glabrous to sparsely pilose with scattered hairs.
- 5a. Spikelets 8.4-11.2 mm long; fertile lemma subulate; foliage leaf blades with the base rounded-attenuate, L : W = 20-40(-45) *C. foliosa*
- 5b. Spikelets 9.8-11.8 mm long; fertile lemma aristate; foliage leaf blades with the base attenuate; L : W = (26-)30-48(-54) *C. subtilis*

Chusquea tomentosa Widmer & L. G. Clark, sp. nov. TYPE: Costa Rica. Cartago: Villa Mills, road to Piedra Alta, 2,880 m, 30 May 1989 (f), Clark, Widmer & Stein 500 (holotype, CR; isotypes, ISC, MO, NY, US). Figure 1A-E.

Culmi 1.3-4 cm diam., 6-9 m alti. Folia culmorum 20.8-29 cm longa; vaginae 11.8-25.4 cm longae, 4-10.5(-14) plo longior quam laminae, abaxiales glabrae; laminae 1.4-5.4 cm longae, erectae, adaxiales pubescentes, abaxiales glabrae. Ramificatio infravaginalis. Vaginae foliorum fimbriatae, fimbriae paucae, 1-2 mm longae, rectae; laminae foliorum 15-27 cm longae, 0.3-0.7(-1.1) cm latae, L : W = 25-40, abaxiales tomentosae, non tessellatae. Paniculae 8-16 cm longae, angustae; rami laxe adpressi. Spiculae 11.5-15 mm longae, scaberulae. Glumae 2, squamiformes. Lemmata sterilia 2, subulata; lemma sterile I 7.2-9.7 mm longum; lemma sterile II 11.7-14 mm longum. Lemma fertile 11.5-13.5 mm longum, subulatum. Palea 9.5-12.1 mm longa, sulcata.

Culms 1.3-4 cm basal diam., 6-9 m tall, erect at the base, arching above and scandent. Internodes (11-14-)18-38(-51) cm long, more or less terete, shallowly sulcate above the central bud, usually smooth to scabrid below the node. Culm leaves 20.8-29 cm long, the juncture of the sheath and blade abaxially a \pm horizontal and distinct line; sheaths 11.8-25.4 cm long, 4-10.5(-14) times as long as the blades, abaxially glabrous, the margins glabrous, one side occasionally minutely ciliate toward the apex; blades 1.4-5.4 cm long, trian-

gular, erect, usually persistent, adaxially pubescent, abaxially glabrous, the apex subulate, the base narrower than the apex of the sheath; girdle 3-5 mm wide, densely pubescent; inner ligule 1-4 mm long, apically ciliate. Nodes with one triangular central bud subtended by 50-60 subsidiary buds; sheath scar dipping away markedly below the bud/branch complement. Branching infravaginal; central bud developing tardily at the middle and upper nodes; leafy subsidiary branches 18-32 cm long, frequently rebranching basally, 60-80(-150) in the mature complement. Foliage leaves 4-9 per complement; sheaths glabrous, the overlapping margin ciliate, the apex with a tuft of fimbriae on either side of the summit, the fimbriae few per tuft, 1-2 mm long, straight, eventually deciduous; blades 15-27 cm long, 0.3-0.7(-1.1) cm wide, L : W = 25-40, adaxially glabrous, sometimes with some scattered hairs, abaxially tomentose and often glaucous, not tessellate, the apex short-setose, the base attenuate to rounded-attenuate; pseudopetiole 1-1.5 mm long; outer ligule an irregular, glabrous rim to 0.5 mm long; inner ligule to 1 mm long, truncate to rounded, pubescent. Panicles 8-16 cm long, narrow, the base often retained within the subtending sheath; rachis triquetrous, glabrous, the edges scabrid; branches loosely appressed, angular, scabrid, the lower ones 3-4 cm long; pedicels 2-6 mm long, angular, scabrid. Spikelets 11.5-15 mm long, scabrid. Glumes 2, scalelike, usually acute, nerves lacking

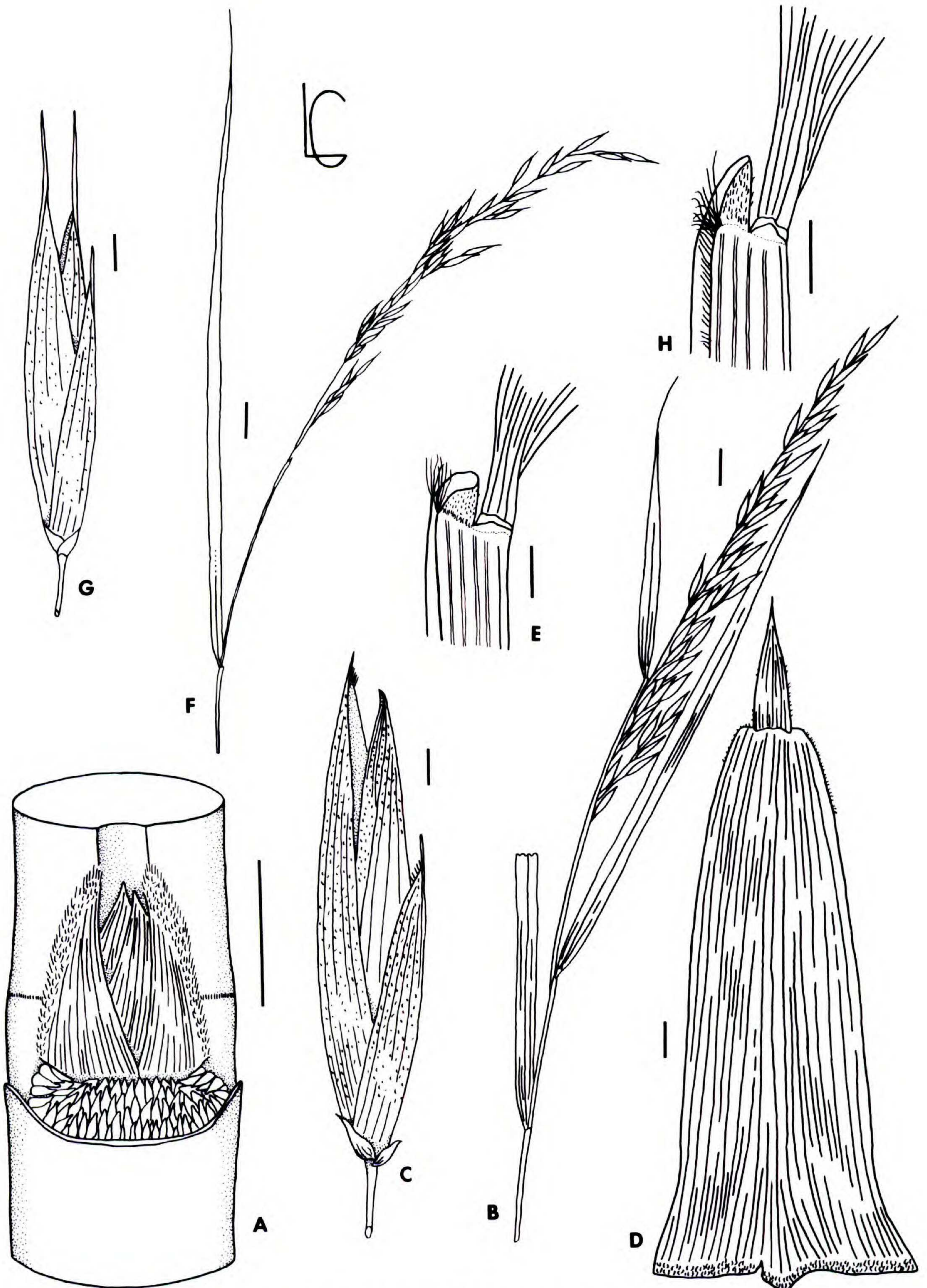


FIGURE 1. *Chusquea tomentosa* and *C. subtilis*. A-E. *C. tomentosa*.—A. Bud complement.—B. Panicle with subtending foliage leaves.—C. Spikelet.—D. Culm leaf, abaxial view.—E. Apex of foliage leaf sheath, showing inner and outer ligules, fimbriae, and pseudopetiole. (A, D based on Clark & Clark 274; B, E based on Widmer 502; C based on Clark *et al.* 500.) F-H. *C. subtilis*.—F. Panicle with subtending foliage leaf.—G. Spikelet.—H. Apex of foliage leaf sheath, showing inner and outer ligules, fimbriae, and pseudopetiole. (F-H based on Widmer 508.) A, B, D, F: bar equal to 1 cm; C, E, G, H: bar equal to 1 mm.

TABLE 1. A morphological comparison of *Chusquea foliosa*, *C. subtilis*, and *C. tomentosa*.

Character	<i>C. foliosa</i>	<i>C. subtilis</i>	<i>C. tomentosa</i>
Culm leaf sheath : blade	1.5–5.4	4.4–6.6	4–10.5(–14)
Foliage leaf sheath apex	fimbriae often curly, 1–2 mm long, many/tuft	fimbriae often curly, 1–1.5 mm long, many/tuft	fimbriae straight, 1–2 mm long, few/tuft
Foliage leaf length : width	20–40(–45)	(26–)30–48(–54)	25–40
Foliage leaf base	rounded-attenuate	attenuate	attenuate to rounded-attenuate
Foliage leaf abaxial pubescence	glabrous to sparsely pilose	glabrous to sparsely pilose	tomentose
Spikelet length	8.4–11.2 mm	9.8–11.8 mm	11.5–15 mm
Sterile lemma I/spikelet	$\frac{2}{3}$ (– $\frac{3}{4}$)	$\frac{2}{3}$ – $\frac{3}{4}$	$\frac{5}{8}$ – $\frac{2}{3}$
Fertile lemma apex	subulate	aristate	subulate

or 1-nerved; glume I ca. $\frac{1}{15}$ the spikelet length, 0.5–1.3 mm long; glume II ca. $\frac{1}{10}$ the spikelet length, 0.7–1.5 mm long. *Sterile lemmas* 2, subulate, abaxially scabrid; sterile lemma I $\frac{5}{8}$ – $\frac{2}{3}$ the spikelet length, 7.2–9.7 mm long, 5- or 7-nerved; sterile lemma II extending the full spikelet length, 11.7–14 mm long, 5-, 7-, or 9-nerved. *Fertile lemma* 11.5–13.5 mm long, subulate, abaxially scabrid, 7–9-nerved. *Palea* 9.5–12.1 mm long, sulcate for most of the length, apiculate, scabrid, 6–8-nerved. *Stamens* 3; anthers 6–8 mm long. *Fruit* unknown.

Additional specimens examined. COSTA RICA. CARTAGO: S slope of Volcán Turrialba, 1–2 km E of Hacienda Central, *Pohl & Davidse 10867B* (ISC); Villa Mills, at Quebrada Voltea, *Widmer 500* (CR, ISC), *501* (CR, ISC); on the path to Cerros Cuericí, *Widmer 502, 503, 504, 506 & s.n.* (CR, ISC); La Esperanza del Guarco, Km 61.8 on the Carretera Interamericana, 4 km NE, 19 Jan. 1990 (fl), *Widmer 505* (CR, ISC). SAN JOSÉ: along the Carretera Interamericana between Km 77 & 78, *Clark & Clark 274* (ISC, MO, US); Cordillera de Talamanca, Km post 107, ca. 20 km N of San Isidro del General along the Carretera Interamericana, *Davidse 761* (ISC); Trinidad de Dota, Km 62.5 along the Carretera Interamericana, 6 Feb. 1990 (fl), *Widmer 507* (CR, ISC).

Chusquea tomentosa is characterized by the abaxially tomentose foliage leaf blades and the scabrid spikelets 11.5–15 mm long. This species occurs in the Cordillera de Talamanca in montane forests at elevations of 2,500 to 3,000 m. It grows on slightly drier sites with southern to southeastern exposures.

Vegetative specimens of *C. tomentosa* were previously assigned to *C. foliosa* L. G. Clark (Clark, 1989). With the advent of flowering in 1989, *C. tomentosa* could be clearly distinguished from *C. foliosa* based on the large spikelets. Vegetatively, the two species are very similar in overall aspect, but may be differentiated by the abaxially tomen-

tose foliage leaf blades and the few, straight fimbriae at the apex of the foliage leaf sheaths of *C. tomentosa*. In *C. foliosa*, the foliage leaf blades are abaxially glabrous to sparsely pilose with scattered hairs, and the fimbriae are more numerous and usually curly. *Chusquea foliosa*, *C. tomentosa*, and *C. subtilis* form a complex of closely related species within sect. *Longifoliae*; a comparison of the three species is presented in Table 1.

Chusquea subtilis Widmer & L. G. Clark, sp. nov. TYPE: Costa Rica. Cartago: Villa Mills, El Sitio, confluence of Quebradas Siberia and Voltea, 2,550 m, 9 Dec. 1988 (fl), *Widmer 508* (holotype, CR; isotypes, CATIE/SBN, ISC, ZT). Figure 1F–H.

Culmi 1.5–3 cm diam., 2–6 m alti. Folia culmorum 19.7–24.3 cm longa; vaginae 17–20 cm longae, 4.4–6.6 plo longior quam laminae, abaxiales pilosae ad basim, glabrae ad apicem; laminae 2.6–4.5 cm longae, erectae, abaxiales sparsim pilosae. Ramificatio infravaginalis. Laminae foliorum (9–)12–21.6 mm longae, 0.3–0.6 cm latae, L : W = (26–)30–48(–54), abaxiales glabrae, non tessellatae. Paniculae (7–)11–18 cm longae, angustae; rami laxe adpressi. Spiculae 9.8–11.8 mm longae, scaberulae. Glumae 2, squamiformes. Lemmata sterilia 2; lemma sterile I 7.5–9.2 mm longum, subulatum; lemma sterile II 9.3–11.8 mm longum, subulatum-aristatum. Lemma fertile 10–11.7 mm longum, aristatum. Palea 7.4–9 mm longa, sulcata tantum ad apicem.

Culms to 1.5–3 cm diam., 2–6 m tall, erect at the base, arching above. *Internodes* to 35 cm long, terete, shallowly sulcate above the central bud, usually scabrid to smooth. *Culm leaves* 19.7–24.3 cm long, the juncture of the sheath and blade abaxially a \pm horizontal and distinct line; sheaths 17–20 cm long, 4.4–6.6 times as long as the blades, abaxially pilose toward the base, glabrous toward the apex; blades 2.6–4.5 cm long, triangular, erect, persistent, adaxially antrorsely pu-

bescent between the nerves, abaxially sparsely pilose, the apex subulate, the base narrower than the apex of the sheath; girdle 0.5–1 cm wide, densely pilose; inner ligule 1–2 mm long, ciliate. *Nodes* with one triangular central bud; sheath scar dipping away markedly below the bud/branch complement. *Branching* infravaginal; central bud developing tardily at the middle and upper nodes; leafy subsidiary branches to 34 cm long, occasionally re-branching basally, 70–80(–100) branches in the mature complement. *Foliage leaves* 3–5 per complement; sheaths glabrous, the overlapping margin ciliate, the apex with a tuft of fimbriae on either side of the summit, the fimbriae numerous per tuft, 1–1.5 mm long, usually curly; blades (9–)12–21.6 cm long, 0.3–0.6 cm wide, L : W = (26–)30–48(–54), adaxially usually glabrous, sometimes with scattered hairs near the midrib, abaxially glabrous, sometimes with scattered hairs, not tessellate, the apex short setose, the base attenuate; pseudopetiole 1–2 mm long, not distinct; outer ligule a minute, glabrous rim 0.1–0.3 mm long; inner ligule to 1 mm long, rounded to irregular, abaxially basally pubescent. *Panicles* (7–)11–18 cm long, narrow, fully exerted from the subtending sheath; rachis triquetrous, glabrous, the edges glabrous to scabrid; branches loosely appressed, angular, glabrous, the lower ones 2–4.5 cm long; pedicels 1–7 mm long, angular, glabrous. *Spikelets* 9.8–11.8 mm long, scabrid. *Glumes* 2, scalelike, nerves lacking; glume I ca. $\frac{1}{20}$ the spikelet length, 0.5–0.8 mm long; glume II ca. $\frac{1}{15}$ the spikelet length, 0.6–1 mm

long. *Sterile lemmas* 2, abaxially scabrid-pubescent, (5–)7-nerved; sterile lemma I $\frac{2}{3}$ – $\frac{3}{4}$ the spikelet length, 7.5–9.2 mm long, subulate; sterile lemma II equalling or nearly equalling the spikelet length, 9.3–11.8 mm long, subulate-aristate. *Fertile lemma* 10–11.7 mm long, aristate, abaxially scabrid-pubescent, 7-nerved. *Palea* 7.4–9 mm long, sulcate only toward the apex, apiculate, scabrid, 4- or 6-nerved. *Stamens* 3; anthers 4.2–5.2 mm long. *Fruit* a caryopsis, 4.7–6 mm long, flattened, grooved along the hilum, the hilum dark reddish brown, the style base persistent.

Additional specimens examined. COSTA RICA. CARTAGO: Cordillera de Talamanca, on the path to Cerros Cuericí, Clark, Widmer & Stein 503 (CR, ISC, MO, NY, US); Villa Mills, Quebrada Voltea, 9 Dec. 1988 (fl), Widmer 509 (CR, ISC); 19 Aug. 1989 (fl), Widmer 511 (CR, ISC); 15 Nov. 1989 (fl), Widmer 513 (CR, ISC); Cerro Abarca, near Río Angeles, 18 Jan. 1989 (fl), Widmer 510 (CR, ISC); Cuericí, 9 Nov. 1989 (fl), Widmer 512 (CR, ISC); Villa Mills, El Sitio, confluence of the Quebradas Voltea and Siberia, 15 Nov. 1989 (fl), Widmer 514 (CR, ISC). SAN JOSÉ: Villa Mills, S of La Georgina, 15 Dec. 1978 (fl), Pohl & Gabel 13725 (ISC, MO).

The specific epithet of *C. subtilis* refers to the fine leaves and delicate aspect of the panicles. This species is characterized by the narrow foliage leaf blades and scabrid-pubescent spikelets 9.8–11.8 mm long with the fertile lemma aristate (Table 1). *Chusquea subtilis* occurs in the Cordillera de Talamanca in montane forests along streams or at humid sites at elevations of 2,550 to 3,000 m.

KEY TO THE SPECIES OF *CHUSQUEA* SECT. *SWALLENCHLOA* IN COSTA RICA
(based on vegetative specimens)

- 1a. Foliage leaf blades 0.4–0.6 cm wide *C. paludicola*
- 1b. Foliage leaf blades 0.7–2.4 cm wide.
 - 2a. Inner ligule of foliage leaves 1–7 cm long, tapering.
 - 3a. Culm leaf sheaths (1.5–)4.5–7 times as long as the blades, the blades adaxially glabrous; foliage leaf blades usually yellowish green *C. amistadensis*
 - 3b. Culm leaf sheaths 5–13 times as long as the blades, the blades adaxially pubescent; foliage leaf blades green *C. longiligulata*
 - 2b. Inner ligule of foliage leaves 0.5–4(–15) mm long, truncate to tapering.
 - 4a. Foliage leaf blades 3–14.5 cm long; culm leaf blades 0.35–1.5 cm long, the sheaths (7–)12–27 times as long as the blades *C. subtessellata*
 - 4b. Foliage leaf blades (5.5–)10–29 cm long; culm leaf blades 1–6.5 cm long, the sheaths (1.5–)2–11 times as long as the blades.
 - 5a. Foliage leaf blades with L : W = 7–12(–17), the base rounded to rounded-truncate *C. vulcanalis*
 - 5b. Foliage leaf blades with L : W = (7–)10–20(–24), the base rounded to attenuate.
 - 6a. Inner ligules of foliage leaves 1–2.5 mm long, truncate to rounded; foliage leaf sheaths often farinose, especially when young; culm leaf blades adaxially scabrid *C. talamancensis*
 - 6b. Inner ligules of foliage leaves (2–)3–15 mm long, usually tapering; foliage leaf sheaths not farinose; culm leaf blades adaxially pubescent *C. tonduzii*

KEY TO THE SPECIES OF *CHUSQUEA* SECT. *SWALLENCHLOA* IN COSTA RICA
(based on vegetative and flowering specimens)

- 1a. Foliage leaf blades 0.4–0.6 cm wide *C. paludicola*
- 1b. Foliage leaf blades 0.7–2.4 cm wide.

- 2a. Panicles open, pyramidal, with stiffly spreading branches *C. tonduzii*
 2b. Panicles \pm congested, often spicate, narrow, with appressed or ascending branches.
 3a. Spikelets glabrous, often slightly falcate; inner ligules of foliage leaves 1–7 cm long, tapering.
 4a. Foliage leaf blades 14–33 cm long, 0.7–2.3 cm wide, L : W = 9–25, green; culm leaf sheaths 5–13 times as long as the blades, the blades adaxially pubescent *C. longiligulata*
 4b. Foliage leaf blades 6–20.5 cm long, 0.7–1.4(–1.8) cm wide, L : W = 7–14.5(–16), usually yellowish green; culm leaf sheaths (1.5–)4.5–7 times as long as the blades, the blades adaxially glabrous *C. amistadensis*
 3b. Spikelets with some degree of pubescence, linear; inner ligules of foliage leaves 0.5–4(–7.5) mm long, rounded to truncate.
 5a. Panicles narrow, spicate, the branches appressed; foliage leaf blades 3–14.5 cm long, 0.7–1.3 cm wide; culm leaf blades 0.35–1.5 cm long, the sheaths (7–)12–27 times as long as the blades *C. subtessellata*
 5b. Panicles somewhat narrow but not spicate, the branches loose and ascending but not tightly appressed; foliage leaf blades (5.5–)10–29 cm long, 1–2.4 cm wide; culm leaf blades 1.5–6.5 cm long, the sheaths (1.5–)2–11 times as long as the blades.
 6a. Foliage leaf blades with L : W = 7–12(–17), the base rounded to rounded-truncate, the sheaths not farinose; spikelets completely pubescent *C. vulcanalis*
 6b. Foliage leaf blades with L : W = (8–)10–20(–24), the base rounded to attenuate-rounded, the sheaths often farinose, especially when young; spikelets scabrid-pubescent except toward the bases of the bracts *C. talamancensis*

***Chusquea talamancensis* Widmer & L. G. Clark, sp. nov.** TYPE: Costa Rica. Cartago: Cordillera de Talamanca, on the path to Cerros Cuericí, 3,030 m, 30 May 1989 (fl), *Clark, Widmer & Stein 502* (holotype, CR; isotypes, ISC, MO, NY, US). Figure 2A–F.

Culmi 0.7–3.8 cm diam., 3–6(–9) m alti. Folia culmorum 15–24 cm longa, farinosae initio; vaginae 10.6–18 cm longae, (1.5–)2–11 plo longior quam laminae, abaxiales glabrae; laminae 1.5–6.5 cm longae, erectae, adaxiales scaberulae, abaxiales glabrae. Ramificatio intravaginalis. Vaginae foliorum plerumque farinosae initio; laminae foliorum 13–29 cm longae, 1–1.8 cm latae, L : W = (8–)10–20(–24), glabrae, abaxiales tessellatae. Paniculae 11–29 cm longae, angustae; rami laxe adpressi. Spiculae 5.6–7.5 mm longae, pubescentes. Glumae 2, squamiformes. Lemmata sterilia 2, subulata; lemma sterile I 4.2–5 mm longum; lemma sterile II 5.3–6.3 mm longum. Lemma fertile 6–7.1 mm longum, apiculatum. Palea 5.6–6.2 mm longa, sulcata ad apicem.

Culms 0.7–3.8 cm basal diam., 3–6(–9) m tall, erect at the base, arching above. *Internodes* (17–19)27–37(–43) cm long, \pm terete, smooth, waxy to farinose. *Culm leaves* 15–24 cm long, the juncture of the sheath and blade an irregular, slightly sloping line, abaxially indistinct, farinose when young; sheaths 10.6–18 cm long, (1.5–)2–11 times as long as the blades, abaxially glabrous; blades 1.5–6.5 cm long, erect, persistent, apiculate, adaxially scabrid, abaxially glabrous; girdle 1–6 mm wide, glabrous; corky ridge present at the juncture of the sheath and girdle; inner ligule 1–2 mm long, stiff, glabrous, irregular. *Nodes* with one triangular central bud subtended by 5–11 subsidiary buds; sheath scar dipping slightly below the branch complement. *Branching* intravaginal; leafy subsidiary branches 35–69 cm long, frequently rebranching basally; 7–30 branches in the mature complement.

Foliage leaves 6–11 per complement; sheaths glabrous, often farinose especially when young; blades 13–29 cm long, 1–1.8(–2.4) cm wide, L : W = (8–)10–20(–24), adaxially and abaxially glabrous, abaxially tessellate, the apex acuminate to short setose, the base rounded to attenuate-rounded; pseudopetiole 2–4 mm long; outer ligule a stiff, glabrous rim 0.3–1 mm long; inner ligule 1–2.5 mm long, truncate to rounded, glabrous, chartaceous. *Panicles* 11–29 cm long, narrow but not spicate, often the base not exerted from the subtending sheath; rachis somewhat complanate, glabrous to scabrid, the edges scabrid; branches loosely appressed, ascending, angular, scabrous, the lower ones 3–9 cm long; pedicels 1.5–4 mm long, angular, scabrid. *Spikelets* 5.6–7.5 mm long. *Glumes* 2, scalelike, abaxially scabrid to pubescent; glume I ca. $\frac{1}{10}$ the spikelet length, 0.6–1 mm long, nerves absent or 1-nerved; glume II ca. $\frac{1}{5}$ the spikelet length, 0.9–1.6 mm long, 1-nerved. *Sterile lemmas* 2, subulate, abaxially pubescent on the upper $\frac{1}{2}$ – $\frac{2}{3}$, otherwise glabrous; sterile lemma I ca. $\frac{2}{3}$ the spikelet length, 4.2–5 mm long, 3- or 5-nerved; sterile lemma II ca. $\frac{1}{10}$ the spikelet length, 5.3–6.3 mm long, 5-nerved. *Fertile lemma* 6–7.1 mm long, apiculate, abaxially pubescent on the upper $\frac{1}{2}$ – $\frac{1}{3}$, otherwise glabrous, 7- or 9-nerved. *Palea* 5.6–6.2 mm long, sulcate toward the apex, the sulcus pubescent, 4-nerved. *Stamens* not seen. *Fruit* a caryopsis.

Additional specimens examined. COSTA RICA. CARTAGO: along the Carretera Interamericana just below páramo, *Clark & Clark 273* (ISC, MO, US); Villa Mills, road to Piedra Alta, *Clark et al. 501* (CR, ISC, MO, NY, US); along Interamerican Highway near Cerro de la Muerte, *Fisher R354* (US). CARTAGO/SAN JOSÉ: Cerro Jaboncillo, along access road to transmission line tower on summit,

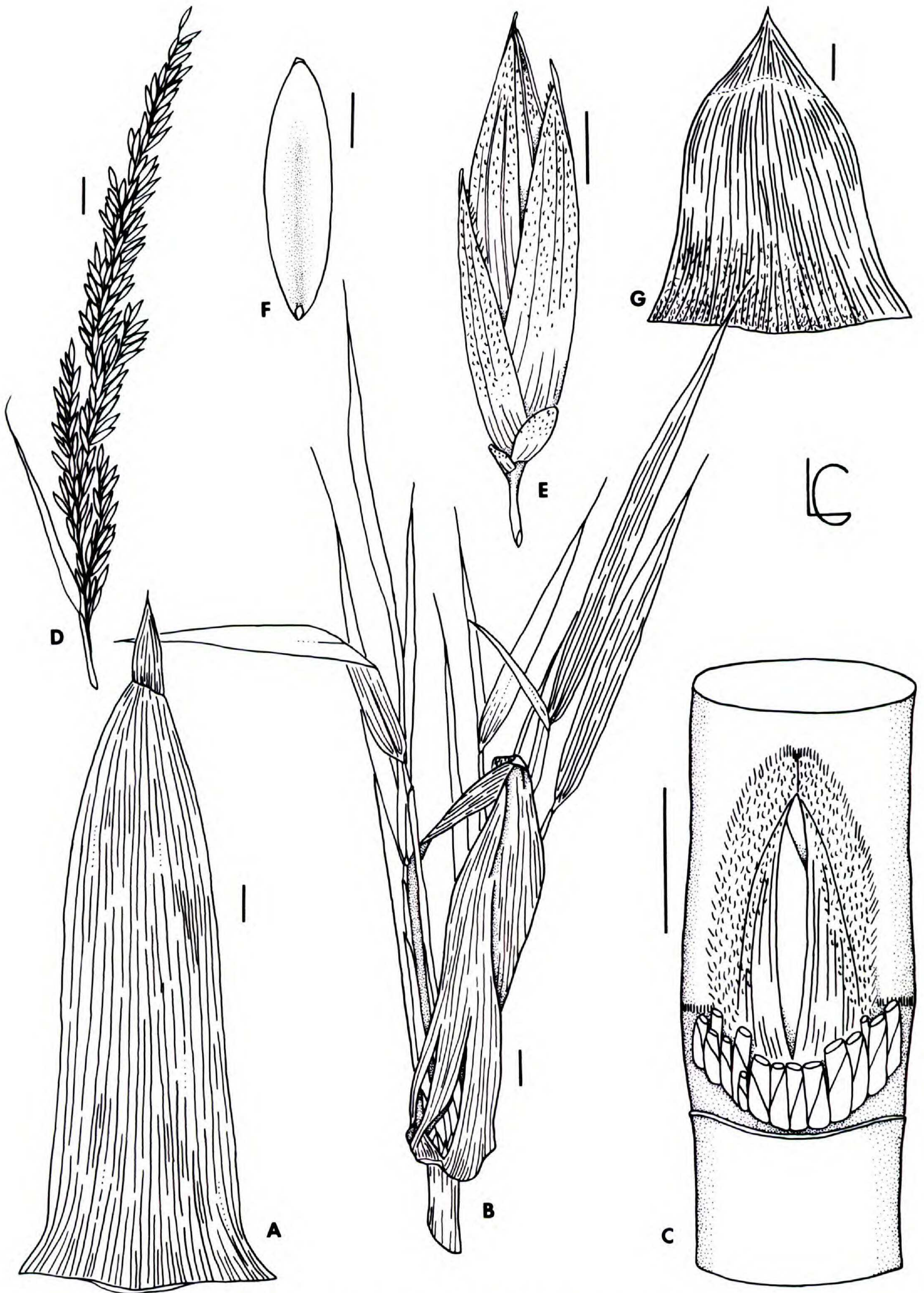


FIGURE 2. *Chusquea talamancensis* and *C. tonduzii*. A-F. *C. talamancensis*.—A. Culm leaf, abaxial view.—B. Branch complement and foliage leaves.—C. Bud/branch complement.—D. Panicle.—E. Spikelet.—F. Caryopsis. (A-C based on Clark & Clark 273; D based on Pohl 15676; E based on Clark et al. 502; F based on Widmer s.n.)—G. *C. tonduzii*, culm leaf, abaxial view (based on Clark et al. 497). A-D, G: bar equal to 1 cm; E-F; bar equal to 1 mm.

TABLE 2. A morphological comparison of *Chusquea vulcanalis*, *C. talamancensis*, and *C. tonduzii*.

Character	<i>C. vulcanalis</i>	<i>C. talamancensis</i>	<i>C. tonduzii</i>
Culm leaf sheath, abaxial	glabrous	glabrous	only basal ½ pubescent to completely glabrous
Culm leaf blade, adaxial	glabrous to scabrid	scabrid	densely pubescent
Foliage leaf blade color	yellowish green	green	green
Foliage leaf blade width	(0.7-)1.1-2.4 cm	1-1.8(-2.4) cm	(0.7-)1-1.5 cm
Foliage leaf length : width	7-12(-17)	(8-)10-20(-24)	(7-)10-19.5
Foliage leaf inner ligule length	1-4(-7.5) mm	1-2.5 mm	(2-)3-15 mm
Foliage leaf sheath	not farinose	often farinose when young	not farinose
Panicle shape	narrow	narrow	pyramidal
Spikelet length	5.7-8.5 mm	5.6-7.5 mm	(5.4-)6-7.6 mm
Spikelet pubescence	completely pubescent	scabrous/pubescent except glabrous toward bases of bracts	glabrous except bracts abaxially apically pubescent
Sterile lemma I/spikelet	$\frac{3}{4}$ - $\frac{7}{8}$	$\frac{2}{3}$	$\frac{1}{2}$
Sterile lemma II/spikelet	($\frac{9}{10}$ -)1	$\frac{9}{10}$	$\frac{2}{3}$

Cerro de la Muerte, *Horn 129, 130* (ISC); power lane 1 km W of Cerro Jaboncillo, Cerro de la Muerte, *Horn 242* (ISC). LIMÓN: on the path to Cerro Chirripó, 2 Apr. 1989 (fl), *Widmer 517* (ISC). PUNTARENAS: Cordillera de Talamanca, upper slopes of Cerro Echandi, *Davidse et al. 23885, 23961* (ISC, MO). SAN JOSÉ: La Georgina, roadside W of Carretera Interamericana, E of restaurant, forest margin, 28 Jan. 1989 (fl), *Pohl 15676* (ISC, MO); La Georgina, *Pohl & Clark 13924* (ISC, MO); La Georgina, opposite the restaurant, *Pohl & Clark 14627* (ISC).

Chusquea talamancensis is characterized by the often farinose foliage leaf sheaths, green foliage leaf blades with the inner ligules 1-2.5 mm long, and pubescent spikelets with sterile lemma II $\frac{2}{3}$ the spikelet length. As indicated by the specific epithet, this species is found in the Cordillera de Talamanca, in upper montane forests at elevations of 2,600 to 3,200 m, usually on northern or northwestern exposures.

Vegetative specimens of *C. talamancensis* were previously assigned to *C. tonduzii* Hackel (Clark, 1989), even though the inner ligules were much shorter than is typical for *C. tonduzii*. The panicle

and spikelets of *C. talamancensis* are very similar to those of *C. vulcanalis*, from which it is vegetatively distinct. The three species are compared in Table 2. The description of the culm leaves of *C. tonduzii* in Clark (1989) is based on specimens of *C. talamancensis*. A complete recent vegetative collection of *C. tonduzii* (*Clark et al. 497*) showed that its culm leaves are very similar to those of *C. paludicola* L. G. Clark (Fig. 2G), but the blades of *C. tonduzii* are adaxially pubescent as in *C. longiligulata* (Soderstrom & Calderón) L. G. Clark.

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